Economic Analysis

Research Paper Series

Industrial Competition, Shifts in Market Share and Productivity Growth

by John R. Baldwin and Wulong Gu

No. 021

Statistics Canada Statistique Canada

Canada

ECONOMIC ANALYSIS RESEARCH PAPER SERIES

The Economic Analysis Research Paper Series provides for the circulation of research conducted by the staff of National Accounts and Analytical Studies, visiting Fellows and academic associates. The research paper series is meant to stimulate discussion on a range of topics including the impact of the New Economy, productivity issues, firm profitability, technology usage, the effect of financing on firm growth, depreciation functions, the use of satellite accounts, savings rates, leasing, firm dynamics, hedonic estimations, diversification patterns, investment patterns, the differences in the performance of small and large, or domestic and multinational firms, and purchasing power parity estimates. Readers of the series are encouraged to contact the authors with comments, criticisms and suggestions.

The primary distribution medium for the papers is the Internet. These papers can be downloaded from the Internet at www.statcan.ca for free. Papers in the series are distributed to Statistics Canada Regional Offices and provincial statistical focal points.

All papers in the Economic Analysis Series go through institutional and peer review to ensure that they conform to Statistics Canada's mandate as a government statistical agency and adhere to generally accepted standards of good professional practice.

The papers in the series often include results derived from multivariate analysis or other statistical techniques. It should be recognized that the results of these analyses are subject to uncertainty in the reported estimates.

The level of uncertainty will depend on several factors: the nature of the functional form used in the multivariate analysis; the type of econometric technique employed; the appropriateness of the statistical assumptions embedded in the model or technique; the comprehensiveness of the variables included in the analysis; and the accuracy of the data that are utilized. The peer group review process is meant to ensure that the papers in the series have followed accepted standards to minimize problems in each of these areas.

Publications Review Committee
Analytical Studies Branch, Statistics Canada
18th Floor, R.H. Coats Building
Ottawa, Ontario, K1A 0T6
Telephone: (613) 951-1804

Industrial Competition, Shifts in Market Share and Productivity Growth

by

John R. Baldwin*
and
Wulong Gu**

11F0027 No. 021
ISSN : 1703-0404
ISBN : 0-662-37521-1

Micro-economic Analysis Division
18th Floor, R.H. Coats Building
Ottawa, K1A 0T6
Statistics Canada

*(613) 951-8588
Email: baldjoh@statcan.ca

**(613) 951-0754
Email: wulong.gu@statcan.ca

July 2004

The authors' names are listed alphabetically.

This paper represents the views of the authors and does not necessarily reflect the opinions of Statistics Canada.

Published by authority of the Minister responsible for Statistics Canada

Aussi disponible en français

Table of Contents

Abstract

This paper investigates the extent to which productivity growth is the result of turnover—the process that shifts output from one firm to another as a result of the competitive process. Turnover occurs because some firms gain market share and others lose it. Some turnover is due to entry and exit. The other part arises from growth and decline in incumbent continuing producers. The paper proposes a method for measuring the impact of plant turnover on productivity growth and outlines how this contribution has changed in Canada as a result of substantial trade liberalization in the 1990s.

Key words: industrial competition, shifts, market share, productivity growth

Executive Summary

Labour productivity growth at the industry level is generated by changes in the underlying micro units. In the first case, it comes from a common factor that is associated with productivity growth that occurs in all plants within an industry denoted as the 'within-plant' component. In the second case, it comes from shifts in economic activity from declining to growing plants (the 'turnover' component). This turnover increases the relative importance of more productive producers. This paper investigates how estimates of the relative importance to overall productivity growth of the 'within-plant' and 'turnover' components can be derived.

It argues that many of the decompositions that have been previously used to estimate these two components are based on mechanical, mathematical decompositions. These decompositions fail to consider the implicit counterfactuals that underlie them. The paper agues that it is best to let economics interpose on the process of choosing a sensible counterfactual.

The paper then proposes a counterfactual for measuring what would have happened if turnover had not occurred and uses this to separate total growth in productivity into a pure or within-plant productivity component and a firm turnover component. It compares the resulting formula to the more conventional estimates and reconciles the two. It shows that the conventional measures of 'within-plant' productivity growth are large because they implicitly capture both 'within-plant' and plant market share shifts.

The formula developed in this paper is then applied to the Canadian manufacturing sector and estimates are derived for each of the last three decades. The estimates show that plant turnover accounts for around half of productivity growth.

The paper then examines how this process has changed over the last three decades. Particular interest is focused on the 1990s when the Canadian manufacturing sector underwent substantial trade liberalization as a result of the Free Trade Agreement with the United States. It shows that market turnover has gone up in the 1990s. In particular, the amount of market share gained by continuing plants has increased and the amount of share lost by exits has increased. But the contribution made by plant turnover to productivity growth has actually fallen in the 1990s. In addition, the correlation of the contribution of turnover at the industry level has fallen between the 1980s and 1990s.

The lack of consistency in interindustry patterns of the contributions that are made by the different components means that the way in which turnover responds to changing productivity differences is highly variable over time. Our empirical results demonstrate that ratios which measure the contribution of market share to growth are not stable over time or across industries. Productivity growth can be attained in different ways. Sometimes it occurs through within-plant growth, sometimes through market share turnover. And while there is a loose relationship between the extent to which scale economies exist as well as the extent to which internal (or within-plant) growth contributes to productivity growth in the 1990s, the nature of this relationship changes over time. This suggests that any claim that it is good to have one source of productivity growth (market share as opposed to within-plant growth) is not warranted. But the issue does suggest a research agenda that needs to be pursued. Understanding the circumstances

that determine when one form arises and what causes changes in the relative importance of one form relative to another will help us to better understand how the competitive system responds to exogenous technical change.

1. Introduction

This paper investigates the extent to which productivity growth is the result of turnover—the process that shifts output from one firm to another as a result of the competitive process. Turnover occurs because some firms gain market share and others lose it. Some turnover is due to entry and exit. The other part arises from growth and decline in incumbent continuing producers.

Empirical studies have shown that there is a substantial amount of reallocation of resources across producers as a result of the growth and decline process that is continuously transferring market share from some firms to others. Several studies have examined the role of this reallocation of outputs and inputs across individual firms in aggregate productivity growth (see Foster, Haltiwanger and Krizan, 2001 for a review). Most of these studies argue that reallocation often accounts for very little of aggregate productivity growth and that the main source of productivity growth comes from productivity growth within plants (see OECD, 2001 and Scarpetta *et al.*, 2002). This paper argues that these findings are misleading and based on imperfect analytical models.

The empirical findings that reallocation is of little importance suggest that an extensive literature on industrial competition, ranging from that of Schumpeter (1942) to Aghion and Howitt (1992), is wrong. In these traditional models, reallocation plays a critical role in aggregate productivity growth.

In this paper, we use a decomposition method that is a variant of that first proposed in Baldwin (1995). We find that changes in market share and industrial competition are much more important to productivity growth than was found in most previous studies. Our decomposition method suggests that changes in market share accounted for about half of the overall productivity growth in Canadian manufacturing over the 1988-1997 period. In contrast, the results from some existing methods indicate that reallocation made little contribution to productivity growth.

The rest of the paper is organized as follows. In the second section, we present a method for measuring the contribution of changes in market share to aggregate productivity growth. In Section 3, we present empirical results from our decomposition method. In Section 4, we discuss alternate methods and reconcile the differences with our methodology. In Section 5, we examine the role of changes in market share in productivity growth for detailed manufacturing industries. Section 6 concludes the paper.

2. Measuring the contribution of output reallocation to productivity growth

There are two main sources of aggregate productivity growth: growth that occurs within plants and growth that occurs because of the reallocation of output across individual plants. When firms introduce innovations and become more productive, aggregate productivity grows. When reallocation occurs from less productive to more productive firms, productivity also increases.

The reallocation of outputs and restructuring takes several forms. At the margin, some firms enter and displace those firms that are less productive, many of whom exit the market. Within the incumbent firm population, some gain market share while others lose market share. This process of reallocation is seen to play a critical role in long-run growth (Schumpeter, 1942).

A number of empirical studies have examined the relative importance of these two sources in productivity growth. In all cases, they start by examining changes in productivity over time and decompose this growth into various components, along the way referring to particular components as 'pure' productivity or 'reallocation' components.

An example is warranted. In this paper, we will focus on labour productivity. The average labour productivity of an industry, is equal to a weighted average of the productivity of individual plants:

(1) $$P_t = \sum s_{it} p_{it} ,$$

where P_t is aggregate labour productivity in the industry in period t, s_{it} is the share of plant i in the industry employment, and p_{it} is labour productivity of plant i in period t.

If we differentiate equation 1, we obtain

(2) $$\delta P_t = \sum s_{it} * \delta p_{it} + \sum p_{it} * \delta s_{it} + \sum \delta s_{it} * \delta p_{it}$$

Rewriting in discrete form, this becomes

(3) $$P_t - P_{t-1} = \sum s_{it-1} * (p_{it} - p_{it-1}) + \sum p_{it-1} * (s_{it} - s_{it-1}) + \sum (s_{it} - s_{it-1}) * (p_{it} - p_{it-1})$$

Productivity growth will be higher if, holding employment share constant, productivity growth is higher within individual plants (the first term). It will be higher if the employment share increases more in higher productivity plants (the second term). It will be higher if productivity growth is higher in those plants where employment share is increasing (the third term).

These decompositions are algebraic manipulations and as such are tautologies. It is the interpretations that are sometimes applied to these terms with which we disagree. Most of the empirical studies label the first term on the right hand side the 'pure' productivity effect, the second term as the 'reallocation' effect. The third term is sometimes allocated to the pure productivity effect, but more frequently as part of the reallocation effect. And the studies then proceed to draw conclusions about the dynamics of the competitive process by providing empirical measures of each of these terms. For example, Hazledine (1985) and Griliches and Regev (1995) use this framework to argue that entry either contributes negatively to productivity growth or that it is unimportant. Bailey *et al.* (1992) also use this framework. More recently, the OECD (2001) and Scarpetta *et al.* (2002) have used this framework to argue that most productivity growth comes from the pure productivity effect and that implicitly the competitive process is of little importance.

These empirical findings appear to challenge the conventional wisdom, that is often associated with Schumpeter (1942), in which the process of creative destruction and the rapid pace of reallocation is deemed to be essential for productivity growth. But the challenge is more apparent than real, since it is a result of taking an approach that is mechanical, that attempts to be model neutral, but that makes very strong and questionable implicit assumptions about the nature of the competitive process.

2.1 Models and counterfactuals

We argue that it is useful to let economics interpose on the mathematics of the decomposition exercise. In particular, we argue that there are a large number of decompositions that can be used, each with a different empirical model or counterfactual underlying it. As economists, we do not have the luxury of arguing that our measures are 'model neutral'.

Counterfactual calculations in economic analysis are not new. Adrian Wood (1995) has used counterfactual calculations to measure the impact of non-competing imports from developing countries on labour markets in developed countries. Bertin, Bresnahan and Raff (1996) used counterfactuals to explore the effect on industrial productivity of reallocating output on a nationwide basis to the most productive plants. Bernard and Jensen (1999) used a counterfactual that removes exports from total shipments at plants to examine the contribution of exporting to productivity growth.

In this section, we will present a decomposition method that measures the contribution that output reallocation across plants makes to productivity growth—but we will be explicit about the counterfactual that underlies it. We then present our empirical results using this model. In the next section, we explain how alternative decompositions implicitly rely on different models of how the world works and we assess their relevance to the issue at hand.

The observed change in labour productivity between two periods t and $t-\tau$ is the sum of changes among the continuing plants (C) and changes due to entering (E) and exiting (X) plants:

(4)
$$\begin{aligned}\Delta P_{t,t-\tau} &= \sum_i s_{it} p_{it} - \sum_i s_{it-\tau} p_{it-\tau} \\ &= \sum_{i\in C}(s_{it} p_{it} - s_{it-\tau} p_{it-\tau}) + \sum_{i\in E} s_{it} p_{it} - \sum_{i\in X} s_{it-\tau} p_{it-\tau}\end{aligned}$$

To measure the contribution from shifts in output across plants, we postulate a counterfactual as to what would have happened in the absence of shifts in market shares between plants. The counterfactual is the event we postulate that would have occurred in the absence of the competition that accompanies market-share changes.

In the particular counterfactual chosen here, we assume that in the absence of the competition that leads to market-share change, both exiting plants and continuing plants would have remained in the market at the end of a period and that there would have been no changes in their output shares during the period. We also assume that there would have been no entering plants.

We also assume that productivity growth in plants that continue over the period was the same as that actually observed. For the exiting plants, we presume that there would have been no productivity change if they had not been forced to exit the marketplace.[1] Both of these assumptions explicitly require us to separate changes in productivity from changes in shares. The latter is probably unrealistic as we shall later argue, but is in the spirit of a decomposition that tries to separate productivity change from changes in market share.

Under these assumptions, the counterfactual output for the exiting and continuing plants in period t can be derived from reallocating the observed output at the end of a period across plants, using their output shares at the start of a period:

(5) $$\hat{y}_{it} = s^{y}_{it-\tau} Y_t, \text{ for } i \in C \text{ and } i \in X,$$

where $s^{y}_{it-\tau}$ is the output share of plant i in period $t-\tau$. A hat over a variable (i.e. $\hat{y}$) is the counterfactual value of the variable. Y_t is the observed output in period t.

The counterfactual employment $\hat{l}_{it}$ for plant i in period t is calculated as the ratio of counterfactual output to labour productivity, where labour productivity is taken to be the actual observed labour productivity:

(6) $$\hat{l}_{it} = \hat{y}_{it} / p_{it} = \left(\frac{s^{y}_{it-\tau}}{s^{y}_{it}} \right) l, \textit{ for } i \in C, \textit{ and}$$
$$\hat{l}_{it} = \hat{y}_{it} / p_{it-\tau} = \frac{Y_t}{Y_{t-\tau}} l_{it-\tau}, \textit{ for } i \in X.$$

In Equation (6), we have made use of the assumption that the productivity of continuing plants in period t is the same as was observed and that the productivity of exiting plants was the same as observed in period $t-\tau$.

From the counterfactual output and employment for the continuing and exiting plants, the counterfactual aggregate labour productivity in period t can be calculated as:

(7) $$\hat{P}_t = \sum_{i \in C} \hat{s}_{it} p_{it} + \sum_{i \in X} \hat{s}_{it} p_{it-\tau},$$

where $\hat{s}_{it}$ is the counterfactual employment share of plant i in period t:

(8) $$\hat{s}_{it} = \frac{\left(s^{y}_{it-\tau} / s^{y}_{it} \right) l_{it}}{\sum_{i \in C} \left(s^{y}_{it-\tau} / s^{y}_{it} \right) l_{it} + \sum_{i \in X} \left(Y_t / Y_{t-\tau} \right) l_{it-\tau}}, \textit{ for } i \in C, \textit{ and}$$
$$\hat{s}_{it} = \frac{\left(Y_t / Y_{t-\tau} \right) l_{it-\tau}}{\sum_{i \in C} \left(s^{y}_{it-\tau} / s^{y}_{it} \right) l_{it} + \sum_{i \in X} \left(Y_t / Y_{t-\tau} \right) l_{it-\tau}}, \textit{ for } i \in X.$$

1 We could have assumed that the productivity of exits would have done as well as the continuing plants that lost market share—but we take the more conservative position here that exits would have made no gains.

The counterfactual change in labour productivity (i.e., the change that would have occurred if labour productivity change was the same as observed, but market shares remained constant between the two periods $t-\tau$ and t) is:

(9)
$$\Delta\hat{P}_{t,t-\tau} = \hat{P}_t - P_{t-\tau}.$$

The portion of productivity changes due to shifts in output shares can be calculated as the difference between observed changes in productivity and the changes yielded by the counterfactual:

(10)
$$\begin{aligned}\Delta P_{t,t-\tau} - \Delta\hat{P}_{t,t-\tau} &= P_t - \hat{P}_t \\ &= \left(\sum_{i\in C} s_{it} p_{it} + \sum_{i\in E} s_{it} p_{it}\right) - \left(\sum_{i\in C} \hat{s}_{it} p_{it} + \sum_{i\in X} \hat{s}_{it} p_{it-\tau}\right)\end{aligned}$$

Rearranging the terms in the equation, we express the contribution from shifts in market share as:

(11)
$$\Delta P_{t,t-\tau} - \Delta\hat{P}_{t,t-\tau} = \sum_{i\in C} (s_{it} - \hat{s}_{it})(p_{it} - p_{xt-\tau}) + \sum_{i\in E} s_{it}(p_{it} - p_{xt-\tau}),$$

where $p_{xt-\tau}$ is the weighted average of labour productivity of all exiting plants, estimated using employment as weights.

The first term measures the contribution to productivity growth from changes in market share among continuing plants. The second term measures the contribution from entry and exit. Together, these two terms measure the effect of output reallocation across plants as is given by our counterfactual. Shifts in output shares across continuing plants contribute positively to productivity growth if output shifts towards the plants that are more productive. Entry and exit make a positive contribution to productivity growth if the entering plants are more productive than the exiting plants.

Equation (11) measures the contribution to productivity growth from the reallocation of outputs among plants. By subtracting this contribution from the total growth in productivity, we obtain an estimate of the remainder—that by construction can be ascribed to productivity changes within plants holding market shares constant. This is:

(12)
$$\Delta P_{t,t-\tau} - (\Delta P_{t,t-\tau} - \Delta\hat{P}_{t,t-\tau}) = \hat{P}_t - P_{t-\tau}.$$

To further examine the sources of the contribution from within-plant changes, we substitute Equation (7) in the above equation:

(13)
$$\begin{aligned}\hat{P}_t - P_{t-\tau} &= \left(\sum_{i\in C} \hat{s}_{it} p_{it} + \sum_{i\in X} \hat{s}_{it} p_{it-\tau}\right) - \left(\sum_{i\in C} s_{it-\tau} p_{it-\tau} + \sum_{i\in X} s_{it-\tau} p_{it-\tau}\right) \\ &= \sum_{i\in C} 0.5(\hat{s}_{it} + s_{it-\tau})(p_{it} - p_{it-\tau}) + \sum_{i\in C} 0.5(p_{it} + p_{it-\tau})(\hat{s}_{it} - s_{it-\tau}) \\ &\quad + \left(\sum_{i\in X} \hat{s}_{it} p_{it-\tau} - \sum_{i\in X} s_{it-\tau} p_{it-\tau}\right).\end{aligned}$$

Equation (13) can be simplified as:

(14)
$$\hat{P}_t - P_{t-\tau} = \sum_{i\in C} 0.5(\hat{s}_{it} + s_{it-\tau})(p_{it} - p_{it-\tau}) + \sum_{i\in C} \left(0.5(p_{it} + p_{it-\tau}) - p_{xt-\tau}\right)(\hat{s}_{it} - s_{it-\tau}).$$

The first term measures the contribution from productivity growth within plants holding their share fixed. It will be called pure productivity growth effect. To interpret the last term, we substitute the counterfactual employment from Equation (8):

(15)
$$\sum_{i\in C}(0.5(p_{it}+p_{it-\tau})-p_{xt-\tau})(\hat{s}_{it}-s_{it-\tau})$$
$$=\sum_{i\in C}(0.5(p_{it}+p_{it-\tau})-p_{xt-\tau})\left(\frac{(p_{it-\tau}/p_{it})l_{it-\tau}}{\sum_{i\in C}(p_{it-\tau}/p_{it})l_{it-\tau}+\sum_{i\in X}l_{it-\tau}}-s_{it-\tau}\right).$$

Equation (15) shows that if all plants had the same productivity growth rates, the term would be equal to zero. Therefore, the second term in Equation (13) reflects the effect of differential rates of productivity growth across plants. The term is negative if differences in productivity growth are associated with the reallocation of workers towards less productive plants—that is, those firms whose productivity is growing do not expand their labour quickly enough to increase their share of total employment.

Putting all this together, we arrive at the following decomposition of productivity growth:

(16)
$$\Delta P_{t,t-\tau}=\sum_{i\in C}(s_{it}-\hat{s}_{it})(p_{it}-p_{xt-\tau})+\sum_{i\in E}s_{it}(p_{it}-p_{xt-\tau})$$
$$+\sum_{i\in C}0.5(\hat{s}_{it}+s_{it-\tau})(p_{it}-p_{it-\tau})+\sum_{i\in C}(0.5(p_{it}+p_{it-\tau})-p_{xt-\tau})(\hat{s}_{it}-s_{it-\tau}).$$

The first term measures the contribution from the reallocation of outputs across continuing plants. The second term represents the contribution from net entry. The third term measures the pure within-plant productivity growth effect. The last term is the contribution from the reallocation of labour due to differential productivity growth across plants. The sum of the first two terms will be taken here to represent the effect of market-share changes. The sum of the last two terms will be taken to represent the contribution from within-plant productivity changes.

3. *Empirical results for the Canadian manufacturing sector*

The data for our analysis come from a longitudinal file that was constructed from Statistics Canada's Annual Survey (Census) of Manufactures (ASM). The ASM covers the entire Canadian manufacturing sector using both survey and administrative data. It collects information on shipments, value added, inventories and employment for about 35,000 manufacturing plants in 1997. Gross output in the file is derived as shipments plus net inventory changes. For this study, the plants in the ASM are grouped into 236 manufacturing industries at the 4-digit 1980 SIC (Standard Industrial Classification, 1980) level.

The longitudinal file developed from the ASM follows manufacturing plants over the 1973-1997 period. Each plant in the file has a unique code that allows us to identify entering, exiting and continuing plants. Investigations have shown that this identifier is not unduly affected by ownership or control change and therefore captures 'true' births and deaths (Baldwin, 1995).[2] In

2 The identifier only changes for a continuing plant when the plant's industry, name and control all change simultaneously.

this paper, we measure market share as the share of a plant in gross output at the four-digit SIC industry level.[3] Labour productivity is measured as real gross output per worker, where real gross output is derived from deflating nominal output of each plant by an output deflator for the four-digit level industry in which the plant is classified.[4]

The reallocation of outputs and productivity growth is examined for three periods: 1973-1979, 1979-1988, and 1988-1997. These periods are chosen to give us broad comparability in terms of growth across the business cycle. Each period spans a growth period and allows us to measure the contribution of changes in market share to productivity growth over a long enough time period to reduce measurement errors that are associated with short-run changes.[5]

For the analysis in the paper, we have deleted those plants that experienced more than 30-fold increases or more than 30-fold declines in labour productivity over a period. Productivity growth of that magnitude in a period of less than ten years is unlikely and appears to be a result of reporting errors.[6] There are a total of 9 such plants in the 1988-1997 period, 10 for the 1979-1988 period and 13 in the 1973-1979 period.[7]

3.1 Shifts in market share

Shifts in market share over the three periods 1973-1979, 1979-1988 and 1988-1997 are calculated for each 4-digit SIC industry and then aggregated to the total manufacturing sector, using the average output of the industry in a period as weights (Table 1). During the 1988-1997 period, 37 percent of market share was transferred from plants that either contracted or closed to new plants or plants that expanded. The continuing plants that increased market share acquired an additional 16 percentage points in market share over the period. The entering plants captured 21 percentage points. The continuing plants that lost market share lost a total of 21 percentage points over the period, while the exiting plants relinquished 16 percentage points. This confirms earlier evidence taken from the 1970s (Baldwin, 1995) that large shifts take place in the market share of manufacturing plants.

---

3 Market share is often measured as share of shipments. This paper focuses on the linkage between reallocation of outputs and changes in gross output per worker. Therefore, we use share of gross output as our measure of market share.

4 While value added per worker is the more conventional measure used, gross output per worker is probably more accurately measured in real terms. Real value added per worker is calculated using double deflation techniques that often yield unstable estimates.

5 They also correspond roughly to periods when the microfile can be used to accurately measure entry. During periods within each of these periods, the comprehensiveness of the frame was allowed to deteriorate slightly; but it was made more comprehensive by the end of the periods chosen. During the periods of deterioration, short-run entry rates are underestimated. Over the longer periods chosen here, this problem is reduced.

6 Removing those plants from the file has virtually no effect on the measured contribution of output reallocation to productivity growth except for the refined petroleum and coal products industry in the 1973-1979 period.

7 We also used two-year moving averages of beginning and terminal periods to check to see whether the results might be affected by the use of only single-period results. There were no meaningful differences between the two sets of results.

Compared to earlier periods in the 1970s and 1980s, the pace of market-share turnover increased in the 1990s. In the latter period, the Canadian manufacturing sector was restructuring in response to the changes brought about by the Free Trade Agreement with the United States and the North American Free Trade Agreement. Shifts in market share were 3.91 percentage points per year for the 1973-1979 period, 3.62 percentage points for the 1979-1988 period, and 4.11 percentage points for the 1988-1997 period.[8]

Table 1. Shifts in market share in aggregate manufacturing

Period	Shifts in market share	Continuing gainers	Continuing losers	Entering plants	Exiting plants
Cumulative changes (% points)					
1973-1979	23.47	10.14	-7.88	13.32	-15.58
1979-1988	32.54	16.36	-15.45	16.18	-17.09
1988-1997	37.00	15.97	-21.13	21.03	-15.86
Average annual changes (% points)					
1973-1979	3.91	1.69	-1.31	2.22	-2.60
1979-1988	3.62	1.82	-1.72	1.80	-1.90
1988-1997	4.11	1.77	-2.35	2.34	-1.76

3.2 Productivity growth

The contribution of this output reallocation to productivity growth is estimated for the three periods, 1973-1979, 1979-1988 and 1988-1997, using the method that was outlined in the last section (Table 2). Labour productivity growth is first decomposed at the 4-digit industry level. These results are then aggregated to the level of the total manufacturing sector using average employment over a period as weights. It should be noted that we divide the within-plant productivity effect into two groups—the portion that comes from growth in continuing plants that are gaining market share and the portion in plants losing market share. Earlier work (Baldwin, 1995) found that most of the within-plant own effect comes from plants that are expanding—and that very little comes from those contracting. The latter group is in the process of losing market share, primarily because they have fallen behind in the productivity race.

The reallocation of outputs is generally as important as within-plant changes for aggregate productivity growth over the 1979-1988 and 1988-1997 periods. Our results show that, for the 1988-1997 period, 53 percent of aggregate productivity growth was due to the reallocation of outputs towards more productive plants (Table 2). The reallocation of output contributed 55 percent for the 1979-1988 period and 72 percent in the 1973-1979 period. For the 1973-1979 period, the reallocation of output across plants was the most important source of productivity growth.

8 Baldwin (1995) found that the shifts in market share in Canadian manufacturing were 37 percentage points per average 4-digit industry for the 1970-1979 period.

Table 2. Decomposition of labour productivity growth in aggregate manufacturing

Period	1973-1979	1979-1988	1988-1997
Productivity growth (% per year)	2.18	1.36	2.93
Contribution from output reallocation:	72.41	54.81	53.05
- output reallocations among continuers	48.10	34.98	38.89
- entry and exit	24.31	19.83	14.16
Contribution from changes within continuing plants	27.59	45.18	46.95
- productivity growth: gainers	62.49	50.70	53.21
- productivity growth: losers	-31.71	9.67	10.31
- productivity-induced employment shifts	-3.19	-15.19	-16.57

The effect of reallocation comes both from entry and exit as well as from shifts in market share among continuing plants. The reallocation effect that comes from continuing plants is more important than the effect arising from the displacement of exiting plants by entering plants. Of the 53 percent contribution from the output reallocation over the 1988-1997 period, 39 percentage points come from the reallocation within the continuing plants, the remaining 14 percentage points are due to entry and exit. This relative difference in the importance of turnover in the two components is also found over the two previous periods.[9]

Most of the within-plant productivity contribution comes from the plants that increased market share. The plants that lost market share had negative or slow growth in labour productivity, contributing only a small share of the with-plant contribution in the 1979-1988 and 1988-1997 periods, and a negative share over the 1973-1979 period. Holding market share constant, productivity growth is associated with the reallocation of labour towards less productive plants. As a result, the contribution from the covariance term is negative.

The results show that the reallocation of output across plants became less important to productivity growth after 1979, while within-plant changes increased in importance. Together with a previous finding that the shifts in market share were higher in the period 1988-1997 than in the period 1973-1979, our results suggest that productivity differences between market-share gainers and market-share losers may have become smaller in the 1990s.

The contribution that entry and exit made to productivity growth declined over time. But within this component, foreign-controlled plants increased their contribution in the 1990s, while the contribution of entry and exit in the domestic sector declined (Baldwin and Gu, 2002).

Finally, it should be noted that shifts in market share are related to productivity growth over time. The greater the shifts in market share in a period, the higher was aggregate labour productivity growth in the period. Aggregate annual labour productivity growth of the total manufacturing sector was 2.18 percent for the 1973-1979 period, 1.36 percent for the 1979-1988 period and 2.93 percent for the 1988-1997 period. A slowdown in productivity growth in the 1979-1988 period relative to the 1973-1979 period occurred as the pace of shifts in market share

9 See Baldwin and Gu (2002) for an analysis of the components of entry that examine the difference between foreign and domestic plants, single enterprise and multi-enterprise plants.

slowed. When the pace of market-share shifts rose in the 1988-1997 period, aggregate productivity growth increased.

4. Sources of productivity growth: Alternative decomposition

Our finding on the importance of the reallocation of outputs differs from those in previous empirical studies (e.g., Foster, Haltiwanger, and Krizan, 2001; OECD, 2001). Most previous studies find that that entry contributes little to productivity growth and that the reallocation process across continuing firms makes a small and often negative contribution to aggregate productivity growth. These studies argue that almost all productivity growth comes from the 'within' component.

It is important to explain why there are differences in our two approaches. In effect, what others call the within-plant component captures both the within-plant growth effect that we have defined and a substantial portion of the productivity growth that arises from shifts in market share.

We consider two other decomposition methods: one by Griliches and Regev (1995) (GR for short) and the other by Foster, Haltiwanger, and Krizan (2001) (FHK for short). These two decomposition methods have been recently adopted by the OECD in their inter-country comparison of the importance of entry and exit for productivity growth in OECD countries (OECD, 2001).

The decomposition due to Griliches and Regev (1995) is:

$$\begin{aligned}\Delta P_{t,t-\tau} = {} & \sum_{i\in C} \overline{s}_i (p_{it} - p_{it-\tau}) + \sum_{i\in C} (s_{it} - s_{it-\tau})(\overline{p}_i - \overline{P}) \\ & + \sum_{i\in E} s_{it}(p_{it} - \overline{P}) - \sum_{i\in X} s_{it-\tau}(p_{it-\tau} - \overline{P})\end{aligned} \tag{17}$$

where Δ denotes changes between two periods t and $t-\tau$. A bar over a variable indicates the average of the variable over the two periods. C denotes continuing plants that are in operation in both periods. E denotes entering plants. X denotes exiting plants.

The first term in the decomposition is categorized by these authors as the within-plant component and is taken to measure the contribution of productivity growth taking place within continuing plants. The second term is referred to as the between-plant component and captures the effect of the compositional shift in employment shares among continuing plants. The between-plant component is positive when labour shifts toward the plants that are more productive. The last two terms are taken to represent the contribution of plant turnover (entering and exiting plants). The sum of the last three terms is defined to measure the effect of reallocation across individual plants.

Foster, Haltiwanger and Krizan (2001) use a modification of the same approach. Rather than averaging shares and productivity between the two periods, they use initial shares and productivity:

$$\Delta P_{t,t-\tau} = \sum_{i\in C} s_{it-\tau}(p_{it} - p_{it-\tau}) + \sum_{i\in C}(s_{it} - s_{it-\tau})(p_{it-\tau} - P_{t-\tau}) \\ + \sum_{i\in C}(s_{it} - s_{it-\tau})(p_{it} - p_{it-\tau}) + \sum_{i\in E} s_{it}(p_{it} - P_{t-\tau}) - \sum_{i\in X} s_{it-\tau}(p_{it-\tau} - P_{t-\tau}). \tag{18}$$

The first and second terms are referred to by the authors as the within-plant component and the between-plant component. The third term is the covariance term in shares and productivity across continuing plants. The last two terms are taken to represent the contribution of plant turnover (entering and exiting plants).

The between-plant and plant-turnover components in the FHK method involve a comparison with the productivity of an average plant. Continuing plants with increasing shares are said to contribute positively to aggregate productivity if they are more productive than an average plant in the base period. Entering plants are said to contribute positively to aggregate productivity if their productivity in the end period exceeds that of an average plant in the base period. For exiting plants, the contribution is said to be positive if they are less productive than an average plant in the base period.

To show the empirical difference that these methods produce, we have recalculated the impact of reallocation using each of these two alternative decomposition methods: FHK and GR decompositions (Tables 3 and 4 respectively).

The results from the FHK and GR decomposition suggest that reallocation across continuing plants made much less of a contribution to aggregate productivity growth than our method indicates. For the 1979-1988 and 1988-1997 periods, the between-plant reallocation made little contribution to aggregate productivity growth. For the 1973-1979 period, the between-plant reallocation made a positive but small contribution. It was much less important than the contribution made by their term for measuring within-plant changes. During all three periods, the predominant source of productivity growth for both the FHK and GR decomposition was their within-plant term.

Table 3. Decomposition of labour productivity growth in aggregate manufacturing: FHK method

Period	1973-1979	1979-1988	1988-1997
Productivity growth (% per year)	2.18	1.36	2.93
Contribution from continuing plants:	75.32	80.21	85.46
- within-plant changes	77.79	102.25	98.06
- between-plant reallocation	28.77	13.38	8.92
- covariance	-31.24	-35.43	-21.52
Contribution from entry and exit	24.68	19.79	14.54
- entering plants	10.89	10.69	8.86
- exiting plants	13.79	9.10	5.68

Table 4. Decomposition of labour productivity growth in aggregate manufacturing: GR method

Period	1973-1979	1979-1988	1988-1997
Productivity growth (% per year)	2.18	1.36	2.93
Contribution from continuing plants:	75.18	81.15	81.78
- within-plant changes	62.13	84.57	87.23
- between-plant reallocation	13.05	-3.42	-5.45
Contribution from entry and exit	24.82	18.85	18.22
- entering plants	5.54	3.33	1.00
- exiting plants	19.28	15.52	17.22

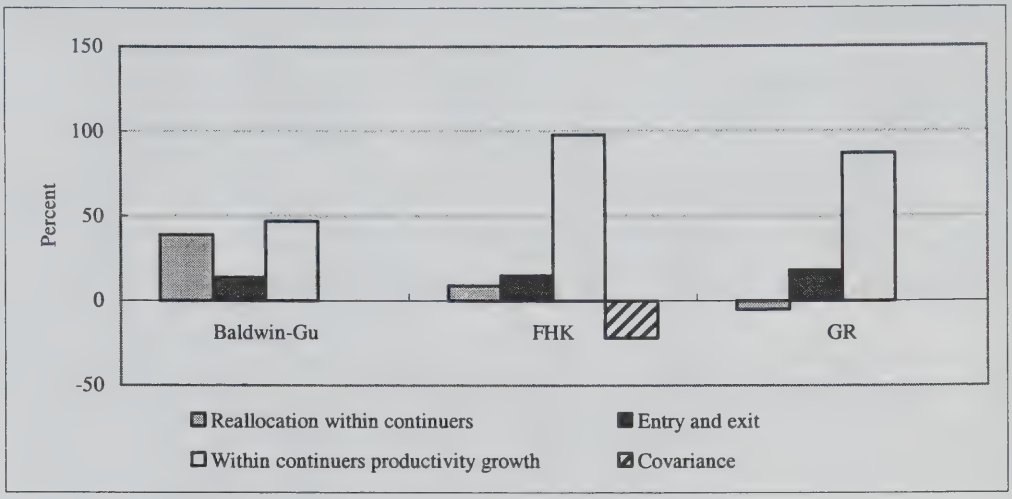
In a related paper (Baldwin and Gu, 2002), we argue that the method that is used by FHK and GR improperly measures the contribution of entry and exit alone to productivity growth.[10] But we also note that these conventional estimates for entry and exit, when summed, closely approximate the net effect of entry and exit derived from the counterfactual that we employ here. It is therefore noteworthy that the measured contribution of the combined effects of entry and exit from the FHK and GR decomposition is similar to the one from our decomposition. The results show that the competitive process that brings new plants into markets and forces old ones out made a positive and significant contribution to productivity growth. It contributed 25 percent to productivity growth in the 1973-1979 period, 19 to 20 percent in the 1979-1988 period, and 15 to 18 percent in the 1988-1997 period.

Both these results contrast with our own that have been presented above, which show that the reallocation that occurs across plants as some firms gain market share is an important source of productivity growth accounting for more than half of total growth (see Figure 1).

The difference between the estimates that we have provided in the first section and the alternatives lies in the counterfactual that underlies each. The reallocation effect from our method is estimated using the counterfactual that without reallocation, productivity in each plant would have grown by the same amount and that market shares would not have changed. The reallocation effect is the difference between actual total productivity growth and the assumed within-plant productivity growth.

10 The implicit assumptions embedded in the counter factual that generates the formula used by FHK/GR approach is that entrants replace existing firms rather than exits.

Figure 1. A comparison of decomposition results (% contribution to labour productivity growth)



In contrast, the implicit counterfactual that is being made in the FHK method and GR approach when measuring the within-plant effect is quite different. The within-plant or pure productivity component in these two approaches involves a term that is the product of employment share and productivity changes. Those who use these models are presuming the following counterfactual for within-plant growth effect—that productivity would have grown by the same amount and that employment shares would not have changed. This assumption is not neutral with respect to market share. It assumes that productivity gains are perfectly reflected in market-share changes. If employment share is held constant, market share must change in exactly the same proportion that productivity changes. The within-plant effect in FHK/GR thus incorporates the effect of changing market shares and, we argue, it is therefore difficult to consider it as a 'pure' effect. Moreover, this counterfactual imbeds very strong assumptions about how market-share growth is related to plant productivity growth, indeed assumptions that may be quite different from those actually taking place.

In fact, while market share responds to productivity changes, the elasticity is generally less than one. For the period 1988-1997, the estimated elasticity of output with respect to labour productivity in the Canadian manufacturing sector is 0.62. This suggests that one percentage point increase in labour productivity is associated with a 0.62 percentage point increase in output. For this reason, the counterfactual implicit in the FHK and GR methods not only includes the effect arising from the reallocation of market share but it will overstate it in the Canadian case. The within-plant component in these approaches combines the within-plant productivity growth as defined in this paper and a portion of productivity growth from market-share changes. As a result, the residual term, the portion of productivity growth that is not accounted for by the within-plant component must correct for the portion of the market-share change that is incorrectly included in the first term if, as explained, the actual market share change is not proportional to productivity changes. Consequently, the estimated remaining term (or terms) from the FHK and GR methods to define the between-plant effect is often small or negative.

The within-plant terms of the alternate FHK/GR decompositions then really combine the effects of productivity changes within plants and the response of market share changes to the changes in productivity. Of course, in some circumstances, we might want to capture the amount of productivity growth that comes both from the productivity growth of plants and from the response of market shares to productivity growth. For this measure, in some sense, better captures the sum total of change that is due to competition. But if the measurement exercise is meant to provide estimates of this competitive process, we believe there is an alternate breakdown that is more transparent of the underlying process at work.

We argue that competition leads some firms to perform better and that their superior performance results in gains in market share. The component of productivity growth generated by those plants gaining market share captures the preponderance of this growth associated with this process.

In Table 2, we have divided within-plant contribution into contributions from market-share gainers, market-share losers and the reallocation of employment across plants (induced by differential productivity growth rates). It is not implausible to argue that the competitive process has different effects on productivity growth for market-share gainers and losers. If we presume that the contribution of losers of market share is not affected by the competitive process, (that is, this amount of productivity growth is essentially exogenous), then it should be excluded from the total effect that is due to competition. If we do so, most of the productivity growth would be attributed to the competitive process—over 91 percent in the 1990s. This is very close to the estimated with-plant component from the FHK and GR methods.

5. Shifts in market share and productivity growth at detailed industries

At an aggregate level, our method of decomposition provides us with an understanding of the size of the contribution that is made by market-share turnover to productivity growth. This in turn emphasizes the importance of the competitive process that shifts market share from one firm to another. At an individual industry level, decompositions enable us to examine differences in the competitive process and to relate it to industry characteristics like scale and capital intensity. When studied over time, they enable us to investigate how the industrial process responds to exogenous events like trade liberalization.

In this section, we examine the shift in market share and its contribution to productivity growth at a detailed industry level and changes that have occurred over the last three decades.

5.1 Shifts in market shares

Market-share changes are endemic to almost all industries. But the process that generates these changes depends very much on the internal dynamics of an industry. Entry and exit of entirely new firms generally take place at the margin of an industry, with small entrants replacing small exits. The amount of entry will depend upon the extent to which there is a large fringe and the height of entry barriers in an industry. And these characteristics are expected to remain relatively constant over time. The amount of entry will change when a period of restructuring develops. In

these circumstances, entry will often be the form in which new more innovative firms enter the market.

On the other hand, the opening and closing of new plants by existing firms depends on the internal dynamics of competition among incumbents. It also depends on the extent to which new technologies and new products are best suited to entirely new plants or whether they can be incorporated in a less costly way into existing plants.

Our results show that there is large reallocation of output across individual plants for most manufacturing industries (Tables 5, 6 and 7). For industries such as Clothing, Furniture and Fixtures, Other Manufacturing, and Leather and Allied Products, half of market share was transferred from plants that either contracted or closed to new plants or plants that expanded over the 1988-1997 period. The shifts in market share were also substantial in the two "high-technology" industries: Electrical and Electronic Products; and Industrial Machinery. The intense competition in those two industries shifted close to half of market share across plants over the 1988-1997 period.

Table 5. Cumulative shifts in market share by industry (%), 1988-1997

Industry	Total shift	Entry	Exit	Continuing gainers	Continuing losers
24. Clothing	53.28	22.48	-43.59	30.80	-9.69
26. Furniture and fixture	51.33	22.43	-42.21	28.90	-9.12
39. Other manufacturing	49.86	27.76	-33.50	22.10	-16.37
17. Leather and allied	49.61	16.32	-45.13	33.29	-4.48
33. Electrical and electronic	48.70	13.54	-35.32	35.15	-13.38
31. Machinery	46.50	18.77	-32.02	27.73	-14.48
30. Fabricated metal	46.17	24.09	-27.92	22.08	-18.25
19. Textile products	43.55	14.49	-34.26	29.07	-9.30
37. Chemical	41.52	18.11	-23.02	23.41	-18.50
28. Printing and publishing	39.37	21.39	-24.69	17.98	-14.68
11. Beverage	38.24	5.65	-33.78	32.59	-4.46
35. Non-metallic mineral	37.42	18.21	-21.66	19.22	-15.76
32. Transportation equipment	37.30	18.46	-13.79	18.84	-23.51
16. Plastic	36.94	20.37	-19.59	16.57	-17.35
10. Food	36.59	15.01	-23.39	21.58	-13.20
25. Wood	35.68	17.11	-20.09	18.57	-15.59
18. Primary textile	33.42	10.02	-22.87	23.39	-10.55
15. Rubber	32.48	21.03	-20.55	11.45	-11.93
27. Paper and allied	23.36	10.63	-6.30	12.73	-17.06
36. Refined petroleum and coal	20.65	4.47	-14.70	16.18	-5.95
29. Primary metal	18.90	6.45	-5.76	12.45	-13.13
12. Tobacco	14.56	0.28	-9.13	14.28	-5.43
Average	37.97	15.78	-25.15	22.20	-12.83

Note: Industries are sorted by shifts in market share.

Table 6. Cumulative shifts in market share by industry (%), 1979-1988

Industry	Total shift	Entry	Exit	Continuing gainers	Continuing losers
24. Clothing	48.05	29.37	-33.96	18.68	-14.09
31. Machinery	47.87	27.21	-28.86	20.66	-19.01
39. Other manufacturing	46.17	31.49	-26.54	14.68	-19.63
26. Furniture and fixture	45.60	28.90	-26.47	16.70	-19.12
30. Fabricated metal	44.71	23.97	-27.10	20.74	-17.61
16. Plastic	42.37	28.81	-16.04	13.56	-26.33
17. Leather and allied	41.66	17.50	-27.40	24.16	-14.26
25. Wood	39.85	23.28	-21.33	16.57	-18.52
33. Electrical and electronic	39.73	18.13	-18.01	21.60	-21.72
19. Textile products	38.81	24.69	-18.67	14.12	-20.14
28. Printing and publishing	36.85	25.09	-17.47	11.75	-19.38
35. Non-metallic mineral	36.59	18.18	-15.57	18.42	-21.02
18. Primary textile	34.77	13.93	-20.00	20.84	-14.77
37. Chemical	34.01	20.65	-11.37	13.37	-22.64
10. Food	31.86	12.47	-17.77	19.40	-14.10
36. Refined petroleum and coal	28.32	6.85	-20.81	21.48	-7.52
12. Tobacco	27.30	0.24	-22.60	27.07	-4.70
15. Rubber	25.55	12.19	-9.54	13.35	-16.01
32. Transportation equipment	25.06	11.98	-5.95	13.08	-19.11
29. Primary metal	23.86	13.65	-4.30	10.20	-19.56
11. Beverage	20.32	3.03	-10.98	17.29	-9.34
27. Paper and allied	16.72	6.60	-4.87	10.12	-11.84
Average	35.27	18.10	-18.44	17.17	-16.84

Note: Industries are sorted by shifts in market share.

Table 7. Cumulative shifts in market share by industry (%), 1973-1979

Industry	Total shift	Entry	Exit	Continuing gainers	Continuing losers
24. Clothing	32.94	16.00	-17.40	16.93	-15.54
26. Furniture and fixture	31.85	15.58	-18.48	16.27	-13.38
25. Wood	31.49	16.15	-14.55	15.34	-16.94
16. Plastic	31.23	21.36	-10.03	9.88	-21.21
17. Leather and allied	28.60	11.37	-15.77	17.24	-12.84
30. Fabricated metal	27.99	17.28	-9.43	10.71	-18.57
39. Other manufacturing	27.76	14.74	-11.82	13.02	-15.93
33. Electrical and electronic	27.59	15.05	-10.62	12.54	-16.97
35. Non-metallic mineral	26.88	11.72	-9.32	15.15	-17.56
31. Machinery	26.82	13.58	-6.16	13.25	-20.67
28. Printing and publishing	25.23	12.19	-11.40	13.04	-13.84
19. Textile products	24.04	8.86	-12.17	15.18	-11.87
10. Food	23.20	8.20	-10.40	15.00	-12.80
32. Transportation equipment	23.05	6.70	-4.85	16.35	-18.20
37. Chemical	22.59	10.69	-5.98	11.90	-16.61
18. Primary textile	22.45	8.56	-12.85	13.89	-9.60
36. Refined petroleum and coal	20.98	9.71	-4.54	11.26	-16.44
12. Tobacco	19.52	3.21	-7.60	16.31	-11.92
11. Beverage	19.46	2.83	-4.55	16.63	-14.91
15. Rubber	18.93	3.19	-3.92	15.74	-15.01
29. Primary metal	16.56	8.49	-1.97	8.08	-14.59
27. Paper and allied	13.03	3.87	-2.60	9.16	-10.42
Average	24.65	10.88	-9.38	13.77	-15.26

Note: Industries are sorted by shifts in market share.

Table 8. Correlations of turnover components (market share transferred) the 2-digit industry level between decades

	Between 1990s and 1980s	Between 1980s and 1970s
Total market share gainers	0.77	0.90
Entering plants	0.83	0.84
Exiting plants	0.68	0.74
Continuing gainers	0.39	0.41
Continuing losers	0.64	0.50
Entry minus exit	0.45	0.46
Gainers minus losers	0.45	0.46

The cross-industry stability of the various turnover components is revealed by the size of the correlations across 2-digit industries between the 1980s and 1990s and between the 1970s and 1980s (Table 8). The cross-industry correlation of entry shares (a measure of entry rates) is about 0.85 between each of the two decades. Entry rate differences are relatively constant across industries. This suggests that the pattern of entry may respond to changing forces but these forces were either absent or had similar effects on most industries during these three decades.

Exits are also closely correlated across decades. But then this is what would be expected if entrants basically drive out exits. The correlation between industry exits in the 1980s and 1990s is lower than between the 1970s and 1980s. This suggests that exits may have begun to respond to new forces, probably associated with trade liberalization, in the 1990s.

The amount of market-share growth in incumbent plants has the lowest correlation across decades. This suggests that the internal dynamics of incumbents is subject to greater change, either because internal coordination in oligopolistic industries is subject to considerable strain over time, or that the emergence of new technologies affects larger plants more than smaller entrants, and it is here that technological change has the most impact on relative market position. The latter is a plausible explanation given the fact that advanced technologies are generally more evident in larger than smaller plants (Baldwin, Rama and Sabourin, 1999).

The three decades studied here have been characterized by progressive trade liberalization, culminating in the Free Trade Agreement between Canada and the United States and the North American Free Trade Agreement between Canada, the United States and Mexico in the 1990s. It is in the latter decade that the industrial structure would have adapted not only to ongoing technological change, but also to restructuring associated with this trade liberalization.

Confirming our expectations, the total amount of market share that is shifted goes up in the 1988-1997 period, both on a weighted basis (Table 1) and on an unweighted basis (Table 9). The source of the changes, however, is somewhat different, depending on whether unweighted or weighted averages are used. On a weighted basis, the market share lost by incumbents increases in the 1990s; on an unweighted basis, it is exits that go up most. We therefore have a widespread phenomenon of exits going up but the largest declines occur in incumbents in large industries. In either case, an adjustment process that sees the decline of some plants accelerates in the 1990s.

Table 9. Average annual market-share changes for 2-digit manufacturing industries, 1970s, 1980s, and 1990s

	1988-1997	1979-1988	1973-1979
Total market-share gainers	4.8	3.9	4.1
Entering plants	2.0	2.0	1.8
Exiting plants	-3.2	-2.0	-1.6
Continuing gainers	2.8	1.9	2.3
Continuing losers	-1.6	-1.9	-2.6
Entry minus exit	-1.2	0.0	0.3
Gainers minus losers	1.2	0.0	-0.3

Note: These are simple averages of the 2 digit industry numbers and differ from Table 1,which provides weighted averages at the level of the economy as a whole.

The increase in market-share reallocation is pervasive across industries, as shown in Figure 2.[11] The total amount of market share shifts at the industry level follows much the same pattern across 2 digit industries for each of the time periods, but is generally higher in the 1990s than in the earlier periods. Entry is, however, generally not higher in the 1990s than earlier periods for most industries (Figure 3), but growing continuing plants generally acquired more market share in the 1990s than earlier periods (Figure 5). On the other hand, exits are much higher in the 1990s across most industries (Figure 4), but continuing plants do not lose more market share in the 1990s (Figure 6).

The period of the 1990s then is substantially different from the earlier periods in terms of the types of adjustment that are taking place. Normally, entry and exit just about balance one another, while so too do the gains and losses in market share in the continuing population. In the 1990s, exits increased across a wide range of industries, not to be replaced by more entrants, but by continuing plant expansion.

It is also noteworthy that the cross-industry patterns of entry and exit maintain their pattern over the three decades. But this is much less so for continuing plants. This confirms the correlation results from Table 8.

11 The rates of change are corrected for the different number of years in each period. This was done by dividing the cumulative change by the number of years in each period.

Figure 2. Total market share shifts

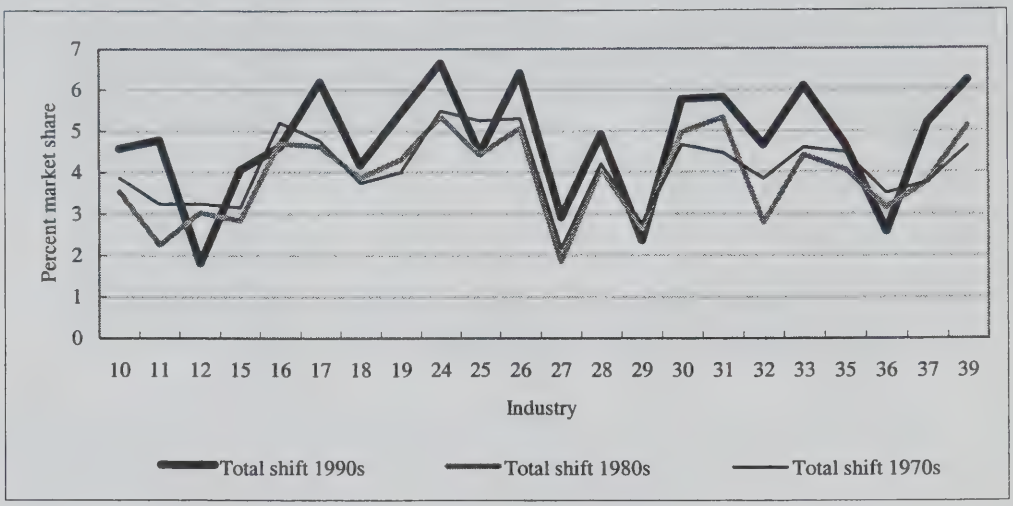


Figure 3. Entry size

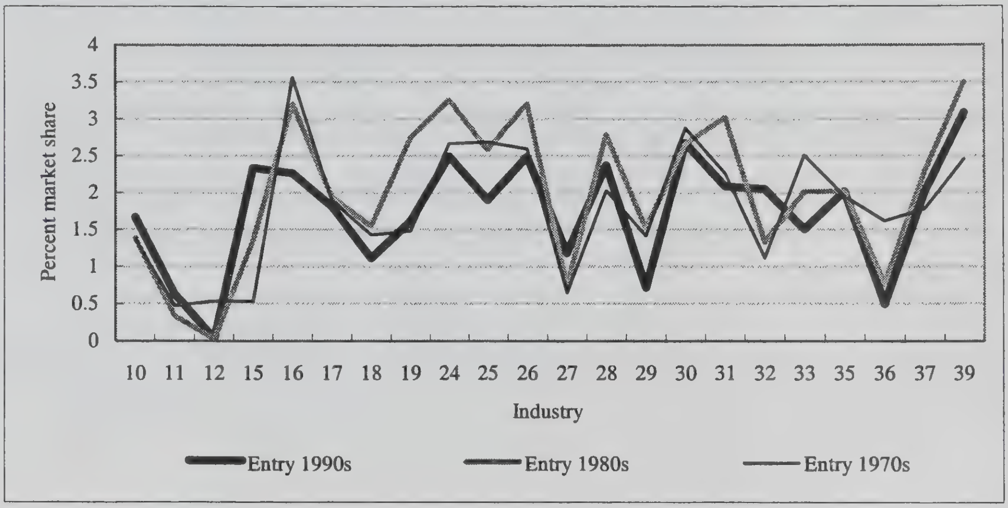


Figure 4. Exit size

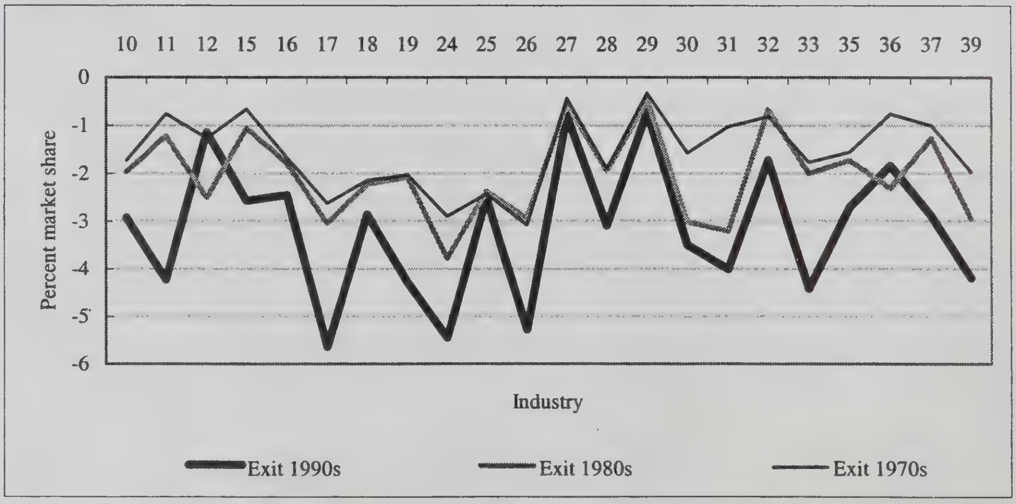


Figure 5. Continuing gainers

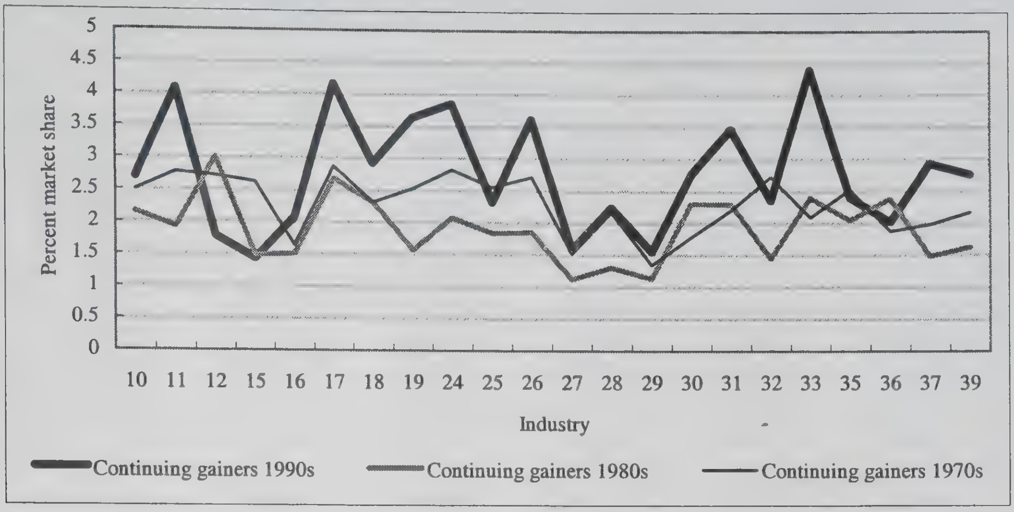
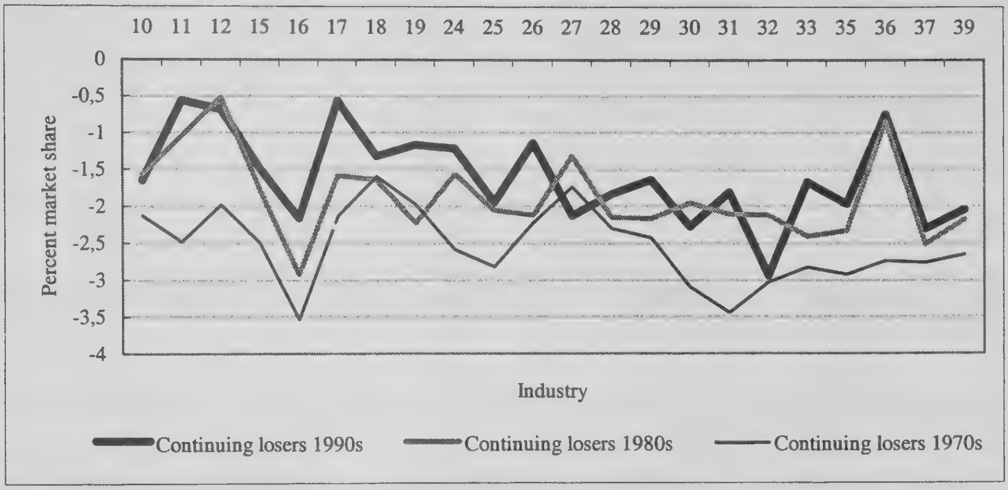


Figure 6. Continuing losers



5.2 Productivity growth

The contribution of market-share reallocation to productivity growth is presented in Tables 10, 11, and 12. The reallocation of output across plants contributes positively to productivity growth in all 22 manufacturing industries over the period 1988-1997 (Table 10). The contribution from between-plant reallocation is also large for most industries. Our results show that the reallocation of output across plants was responsible for more than half of productivity growth in 13 of the 22 manufacturing industries. For Leather and Allied, Non-metallic Mineral, Clothing and Textile Products, 90 to 100 percent of productivity growth was due to the reallocation of output towards more productive plants. It is in the atomistic industries where turnover in market share contributes most to productivity growth. Elsewhere in industries where economies of scale are more important (transportation equipment, refined petroleum, chemicals, primary metal, pulp and paper), within-plant productivity growth accounts for a larger proportion. However, even in these industries, market-share turnover makes an important contribution to overall productivity growth.

Table 10. Decomposition of labour productivity growth, 1988-1997

Industry	LP growth (% per year)	Percentage contribution			
		Output Shifts: continuers	Entry and exit	Pure within-plant growth	LP-induced labour shifts
17. Leather and allied	1.18	78.81	23.60	-1.11	-1.29
35. Non-metallic mineral	1.88	70.97	20.89	12.47	-4.33
24. Clothing	2.42	54.40	33.95	16.29	-4.65
19. Textile products	1.51	70.31	17.60	20.58	-8.48
37. Chemical	2.74	59.23	22.84	50.57	-32.63
33. Electrical and electronic	9.34	67.88	11.31	36.40	-15.59
26. Furniture and fixture	2.64	60.86	15.47	40.37	-16.70
30. Fabricated metal	0.69	39.11	34.27	46.93	-20.31
10. Food	1.26	69.37	3.17	54.26	-26.80
31. Machinery	2.79	65.51	5.10	53.51	-24.12
11. Beverage	5.26	68.14	0.91	44.51	-13.55
25. Wood	1.47	36.93	19.65	79.95	-36.53
39. Other manufacturing	1.50	50.18	5.46	103.89	-59.52
15. Rubber	4.00	18.82	28.02	57.68	-4.52
18. Primary textile	2.98	31.25	4.29	73.51	-9.05
16. Plastic	1.13	26.45	8.56	70.23	-5.25
27. Paper and allied	2.70	16.38	16.05	80.98	-13.41
32. Transportation equipment	3.86	6.87	21.09	85.79	-13.75
36. Refined petroleum and coal	3.65	25.02	1.95	83.83	-10.80
29. Primary metal	4.04	16.44	7.59	74.82	1.15
12. Tobacco	2.47	24.73	-5.99	122.19	-40.93
28. Printing and publishing	-1.06	-67.78	17.77	95.88	54.13
Average	2.66	40.45	14.25	59.25	-13.95

Note: LP denotes labour productivity (gross output per worker). Industries are sorted by the contribution from the reallocation of outputs (sum of reallocation among continuers plus net entry).

There was rapid technical progress in the electrical and electronic products, industrial machinery and chemical and chemical products industries in the 1990s. Labour productivity growth was high at plants in those high-tech industries. However, our results show that the within-plant component accounted for less than half of productivity growth in those industries over the 1988-1997 period. Most of productivity growth (70 to 80 percent) in those industries comes from the reallocation of output towards more productive plants. The competitive process that causes more productive plants to gain market share from the less productive ones drives the rapid productivity growth in the high-tech sector.

The decomposition results allow us to ascertain whether the patterns of the contributions change over time. The relative importance of within-plant vs. between-plant components depends not only on the extent to which market share is being shifted from losers to gainers; it also depends on the extent to which productivity differences develop between the two groups. The latter is a function of the pace of technological change that opens up productivity gaps between the two groups. It also depends on the technological environment. In a stable environment, the contribution of within-plant productivity growth or market share turnover will remain relatively constant; in a changing environment, the relative importance of the two factors will change.

Table 11. Decomposition of labour productivity growth, 1979-1988

Industry	LP growth (% per year)	Percentage contribution			
		Output shifts: continuers	Entry and exit	Pure within-plant growth	LP-induced labour shifts
36. Refined petroleum and coal	-0.98	1,004.75	-119.24	-558.34	-227.17
26. Furniture and fixture	0.20	301.14	-10.57	-207.65	17.08
35. Non-metallic mineral	0.08	242.77	13.47	-73.96	-82.28
17. Leather and allied	0.35	109.38	98.45	-119.63	11.81
11. Beverage	1.64	120.75	1.13	29.66	-51.54
24. Clothing	0.82	54.02	55.82	-0.87	-8.97
39. Other manufacturing	0.39	33.90	67.48	0.37	-1.74
12. Tobacco	4.01	106.79	-6.40	31.46	-31.85
19. Textile products	0.64	73.20	20.50	35.89	-29.58
37. Chemical	2.42	43.27	44.63	33.49	-21.39
28. Printing and publishing	0.68	38.90	48.29	-11.88	24.69
31. Machinery	0.34	166.96	-89.62	59.18	-36.52
10. Food	1.03	59.58	16.72	24.88	-1.18
29. Primary metal	2.21	24.74	36.61	54.12	-15.47
30. Fabricated metal	0.44	72.96	-25.42	83.26	-30.80
25. Wood	3.60	20.74	22.92	64.23	-7.88
33. Electrical and electronic	2.83	17.05	20.28	91.20	-28.53
18. Primary textile	3.46	10.98	25.66	94.91	-31.55
27. Paper and allied	2.47	18.99	9.35	77.21	-5.55
16. Plastic	1.16	-14.81	42.38	85.35	-12.93
32. Transportation equipment	3.04	11.48	14.31	85.30	-11.10
15. Rubber	-0.69	-173.89	-42.82	287.14	29.57
Average	1.37	106.53	11.09	7.51	-25.13

Note: LP denotes labour productivity (gross output per worker). Industries are sorted by the contribution from the reallocation of outputs (sum of reallocation among continuers plus net entry).

We therefore ask whether the contributions from shifts in market share as opposed to within-plant growth remain constant over time.[12] To do so, we calculate the correlations of these contributions between the 1990s and 1980s, then between the 1980s and the 1970s. The results in Table 13 confirm that the 1990s involved a substantial change from the earlier period. Between the 1970s and 1980s, the correlation of labour productivity growth at the industry level was 0.43. This fell to only 0.26 between the 1980s and 1990s. The industries that had done well in the earlier two decades were no longer the ones doing well in the 1990s.

Perhaps more indicative of change are the correlations of contributions from various sources. The contribution of market share reallocation has a 0.40 correlation across industries between the 1970s and 1980s. This completely disappears between the 1980s and 1990s. Similarly, the correlation of within-plant contribution between the 1970s and 1980s, which was 0.41 falls to 0.01 between the 1980s and 1990s.

12 The contributions are shown in Tables 10, 11 and 12 for the periods 1988-1997, 1979-1988, and 1973-1979, respectively.

Table 12. Decomposition of labour productivity growth, 1973-1979

Industry	LP growth (% per year)	Percentage contribution			
		Output shifts: continuers	Entry and exit	Pure within-plant growth	LP-induced labour shifts
26. Furniture and fixture	0.26	397.82	8.78	-341.04	34.43
11. Beverage	0.66	211.63	25.24	-164.53	27.65
30. Fabricated metal	0.83	65.02	104.56	-44.73	-24.85
36. Refined petroleum and coal	1.09	120.96	38.60	-47.71	-11.84
18. Primary textile	4.88	116.79	12.37	37.21	-66.37
31. Machinery	1.86	73.83	17.75	25.49	-17.07
16. Plastic	1.80	38.78	50.85	25.97	-15.59
10. Food	1.93	52.80	27.93	7.89	11.38
39. Other manufacturing	1.77	60.82	14.24	45.44	-20.49
27. Paper and allied	1.03	51.16	22.25	30.70	-4.11
29. Primary metal	1.81	43.46	24.29	20.10	12.15
35. Non-metallic mineral	1.76	45.77	20.64	54.23	-20.63
25. Wood	1.98	28.26	37.26	31.55	2.92
37. Chemical	3.38	41.83	21.78	33.52	2.87
24. Clothing	3.88	33.26	23.33	43.90	-0.50
33. Electrical and electronic	2.48	24.64	29.29	47.61	-1.53
12. Tobacco	4.93	48.19	5.63	50.48	-4.30
28. Printing and publishing	2.72	33.54	16.74	57.32	-7.61
17. Leather and allied	3.38	34.86	10.54	61.23	-6.63
32. Transportation equipment	1.99	30.11	13.08	58.23	-1.43
19. Textile products	3.15	38.40	2.20	64.69	-5.29
15. Rubber	2.27	-37.58	0.60	119.53	17.46
Average	2.27	70.65	24.00	9.87	-4.52

Note: LP denotes labour productivity (gross output per worker). Industries are sorted by the contribution from the reallocation of outputs (sum of reallocation among continuers plus net entry).

In sum, there is far less stability over time in the contribution that each component makes to productivity growth than there is in the nature of the turnover process. We believe that this stems from the fact that the dynamic process that accompanies technological change is not static. At times, new technologies will be introduced in existing plants and these will improve relative productivity and their market share. At other times, these new technologies will be best introduced into new plants and these will expand relative to incumbents. Our data show that there is no single stable pattern that can be easily generalized.

We know that turnover responds to relative productivity differences. While market share growth in a period is not related to the beginning-period labour productivity, it is strongly related to labour productivity growth over the period, and therefore the end-period labour productivity (Baldwin, 1995; Baldwin and Sabourin, 2002). Growing firms have managed to do things better—whether it be from increasing their use of capital (a difficult task) or finding ways to improve their efficiency.

Table 13. Correlations of % contributions to labour productivity growth at the 2-digit industry level between decades

	Between 1990s and 1980s	Between 1980s and 1970s
Labour productivity growth	0.26	0.43
Contribution from output reallocation	0.01	0.41
- reallocation among continuers	0.08	0.40
- entry and exit	0.24	-0.17
Contribution from within-plant growth	0.01	0.41

But the lack of consistency in interindustry patterns of the contributions from various components means that the way in which turnover responds to changing productivity differences is highly variable over time. And whether it is new plants or continuing plants that do so is not fixed in advance.

By itself, the positive contribution to productivity growth from plant turnover indicates that productivity growth is higher than would be the case if there had been no shifts in market share. But we can still ask the question: is productivity growth higher where contributions from turnover are higher?[13] To answer this question, we calculate the correlations between the contributions from various sources and productivity growth. We choose two measures of productivity growth—the actual rate of productivity growth and just that component that stems from market-share turnover.

The results in Table 14 show little in the way of generalities. On the whole, the contribution from market share shifts is negatively related to productivity growth in the 1970s. While positive in the 1980s and 1990s, it is not large enough to be meaningful. The results are no more enlightening when we use the correlations with residual productivity growth. All this suggests that there is no simple connection between the type of market-share change and the amount of productivity growth—and once more suggests that the process that goes from new technologies, to market-share change to productivity growth is complex.

Table 14. Cross-industry correlations between labour productivity growth and % contributions

	1988-1997		1979-1988		1973-1979	
	Total	Residual	Total	Residual	Total	Residual
Contribution from output reallocation	0.21	0.38	0.21	-0.83	-0.51	0.15
- reallocation among continuers	0.28	0.40	0.28	-0.86	-0.42	0.16
- entry and exit	-0.21	-0.51	-0.21	0.53	0.40	-0.01
Contribution from within-plant growth	-0.21	-0.39	-0.21	0.83	0.51	-0.15

Note: The residual measure is the measure that arises from market-share turnover.

13 A large number of studies have examined the issue. In particular, they ask the question of whether entry rates and exit rates are related to productivity growth or employment growth in industries and regions (e.g., Callejon and Segarra, 1999; Audretsch and Fritsch, 2002).

6. Conclusion

In this paper, we have examined the contribution that the reallocation of outputs across plants has made to productivity growth in Canadian manufacturing over the last three decades. We find that a main source of productivity growth in most manufacturing industries is the competitive process that shifts output shares toward the plants that are more productive. For the aggregate manufacturing sector, more than half of overall productivity growth is due to changes in market share across plants in the periods examined: 1973-1979, 1979-1988, and 1988-1997.

The paper also asks why others have reported that reallocation contributes little to productivity growth. In an earlier paper (Baldwin and Gu, 2002), we showed that conventional formulae that are used to measure the importance of entry and exit incorrectly measure its contribution to productivity growth—that these papers implicitly assume that entrants replace continuing firms. When the impact of entry is calculated from an alternate assumption (that entrants replace exits most of the time), the contribution of entry to productivity growth increases substantially.

In this paper, we extend our analysis to measure the contribution of changing market share within the incumbent population. Whether it comes from entry and exit, or growth and decline in incumbents, the reallocation of market share has a considerable impact on productivity growth. Other researchers, who argue that productivity growth comes primarily from productivity growth that is internal to firms, have implicitly included much of the effect of reallocating market share in their within-plant productivity term. Their large numbers combine the within-plant productivity effect and the reallocation effect that we have separated in this paper.

While this paper argues for the importance of the competitive process, it poses a cautionary note when it comes to the use of simple summary statistics on the importance of turnover. There is a tendency to use these statistics to infer how dynamic a country or an industry is (OECD, 2001; Scarpetta *et al.*, 2002). Our empirical results demonstrate that ratios that measure the contribution of market share to growth are not stable over time or across industries. Productivity growth can be attained in different ways. Sometimes it occurs through within-plant growth, sometimes through market share turnover. And while there is a loose relationship between the extent to which scale economies exist and internal-plant productivity growth contributes to overall productivity growth in the 1990s, the nature of this relationship changes over time. This suggests that a simple generalization that argues it is good to have one source of productivity growth (market share as opposed to internal or within-plant growth) is not warranted.

References

Aghion, Philippe and Peter Howitt. 1992. "A model of growth through creative destruction." *Econometrica,* 60(2): 323-51.

Ahn, Sanghoon. 2001. "Firm dynamics and productivity growth: a review of micro evidence from OECD countries." Economics Department Working Paper No. 29. Paris: OECD.

Audretsch, D.B and M. Fritsch. 2002. "Growth Regimes over Time and Space." *Regional Studies,* 36(2): 113-124.

Bailey, Martin Neil, Charles Hulten and David Campbell. 1992. "Productivity Dynamics in Manufacturing Plants." *Brookings Papers on Economic Activity*. Microeconomics: 187-249.

Baldwin, John R. 1995. *The Dynamics of Industrial Competition: A North American Perspective* Cambridge: Cambridge University Press.

Baldwin, John R. 1996. "Productivity growth, plant turnover and restructuring in the Canadian manufacturing sector." In *Sources of Productivity Growth.* Edited by D.G. Mayes. Cambridge: Cambridge University Press.

Baldwin, John R. and Wulong Gu. 2002. *Plant Turnover and Productivity Growth in Canadian Manufacturing*. STI Working Paper 2002/3. Organization of Economic Cooperation and Development. Paris: OECD.

Baldwin, J.R., E. Rama and D. Sabourin. 1999. *Growth of Advanced Technology Use in Canadian Manufacturing During the 1990s.* Analytical Research Paper Series 11F0019MIE1999105. Analytical Studies Branch. Ottawa: Statistics Canada.

Baldwin, John R. and David Sabourin. 2002. "Advanced technology use and firm performance in Canadian manufacturing in the 1990s." *Industrial and Corporate Change,* 11(4): 761-89.

Bernard, Andrew B. and J. Bradford Jensen. 1999. "Exporting and Productivity." NBER Working Paper no. 7135.

Bertin, Amy L., Timothy F. Bresnahan and Daniel M.G. Raff. 1996. "Localized competition and the aggregation of plant-level increasing returns: blast furnaces, 1929-1935." *Journal of Political Economy,* 104(2): 241-66.

Callejon, M. and A. Segarra. 1999. "Business Dynamics and Efficiency in Industries and Regions: the Case of Spain." *Small Business Economics,* 13(4): 253-271.

Foster, Lucian, John Haltiwanger and C.J. Krizan. 2001. "Aggregate productivity growth: lessons from microeconomic evidence." In *New Developments in Productivity Analysis*. Edited by C.R. Hulten, E.R. Dean and M.J. Harper. Chicago: The University of Chicago Press.

Griliches, Zvi and Haim Regev. 1995. "Productivity and firm turnover in Israeli industry: 1979-1988." *Journal of Econometrics,* 65(1): 175-203.

Harris, R.G. 2002. "The new economy and the exchange rate regime." In T.J. Courchene (ed.), *Money, Markets, and Mobility, Celebrating the Ideas of Robert A. Mundell, Nobel Laureate in Economic Sciences.* Kingston and Montreal: John Deutsch Institute for the Study of Economic Policy and IRPP.

Hazledine, T. 1985. "The Anatomy of Productivity Growth Slowdown and Recovery in Canadian Manufacturing." *International Journal of Industrial Organization 3: 307-26.*

Organization of Economic Cooperation and Development. 2001. "Productivity and Firm Dynamics: Evidence from Microdata." OECD Economic Outlook, 69 (June), Chapter 7. Paris: OECD.

Scarpetta, S., P. Hemmings, T. Tressel and J. Woo. 2002. "The Role of Policy and Institutions for Productivity and Firm Dynamics: Evidence from Micro and Industry Data." *Economics Department Working Paper No. 329.* Organization for Economic Cooperation and Development. Paris: OECD.

Schumpeter, J.A. 1942. *Capitalism, Socialism, and Democracy.* New York: Harper and Brothers.

Wood, Adrian. 1995. *North-South Trade, Employment and Inequality: Changing Fortunes in a Skill-Driven World.* Oxford: Clarendon Press.

ECONOMIC ANALYSIS (EA)
RESEARCH PAPER SERIES

No. 001 *A Comparison of Canada-U.S. Economic Growth in the Information Age, 1981-2000: The Importance of Investment in Information and Communication Technologies,* ***Philip Armstrong, Tarek M. Harchaoui, Chris Jackson and Faouzi Tarkhani (March 1, 2002)***

No. 002 *Purchasing Power Parity: A Canada/U.S. Exploration,* ***Beiling Yan (May 2002)***

No. 003 *The Trend to Smaller Producers in Manufacturing: A Canada/U.S. Comparison,* ***John Baldwin, Ron S. Jarmin, Jianmin Tang (May 2002)***

No. 004 *Foreign Affiliate Trade Statistics – 1999: How Goods and Services are Delivered in International Markets,* ***Balance of Payments Division, Colleen Cardillo (April 2002)***

No. 005 *Regional Manufacturing Employment Volatility in Canada: The Effects of Specialization and Trade,* ***John Baldwin and W.Mark Brown (April 11, 2003)***

No. 006 *Growth History, Knowledge Intensity and Capital Structure in Small Firms,* ***G.Gellatly, S.Thornhill, A.Riding (August 6, 2003)***

No. 007 *Accounting for Greenhouse Gases in the Standard Productivity Framework,* ***Tarek Harchaoui, Dmitry Kabrelyan and Rob Smith (November 1, 2002)***

No. 008 *Overcoming Distance, Overcoming Borders: Comparing North American Regional Trade,* ***W.Mark Brown (April 16, 2003)***

No. 009 *Assessing the Impact of Greenhouse Gas Emissions on Canada's Productivity Growth, 1981-1996: An Expermental Approach,* ***Tarek M. Harchaoui and Pierre Lasserre (November 1, 2002)***

No. 010 *A Frontier Approach to Canada-U.S. Multifactor Productivity Performance,* ***Kaïs Dachraoui, Tarek M. Harchaoui (April 3, 2003)***

No. 011 *Participation in Export Markets and Productivity Performance in Canadian Manufacturing,* ***John R.Baldwin, Wulong Gu (August 13, 2003)***

No.012 *Impact of Advanced Technology Use on Firm Performance in the Canadian Food Processing Sector,* ***John R.Baldwin, David Sabourin and David Smith (June 3, 2003)***

No.013 *Foreign Affiliate Trade Statistics – Canadian Operations Abroad, 1999 to 2001-* ***Balance of Payments Division, by Michael Marth (May 2003)***

No.014 *The Effect of Tariff Reductions on Firm Size and Firm Turnover in Canadian Manufacturing,* ***Wulong Gu, G.Sawchuk, L.Whewell (August 19, 2003)***

No.015 *The Sources of Growth of the Canadian Business Sector's CO2 Emissions, 1990-1996,* ***by Kaïs Dachraoui, Gerry Gravel, Tarek M. Harchaoui and Joe St. Lawrence (September 2003)***

No.016 *The Impact of Self-employment on Labour Productivity Growth: A Canada and United States Comparison,* ***John R. Baldwin, James Chowhan (August 21, 2003)***

No.017 *Public Capital and Its Contribution to the Productivity Performance of the Canadian Business Sector,* ***Tarek M. Harchaoui and Faouzi Tarkhani (November 12, 2003)***

No.018 *Prosperity and Productivity: A Canada-Australia Comparison,* ***Tarek M. Harchaoui, Jimmy Jean and Faouzi Tarkhani (December 9, 2003)***

No.019 *Hollowing-out, trimming-down or scaling-up? An Analysis of head Offices in Canada, 1999-2002,* ***John Baldwin, Desmond Beckstead and Mark Brown (December 8, 2003)***

No.020 *forthcoming*

No.021 *Industrial Competition, Shifts in Market Share and Productivity Growth.* ***John Baldwin and Wulong Gu (July 22, 2004)***